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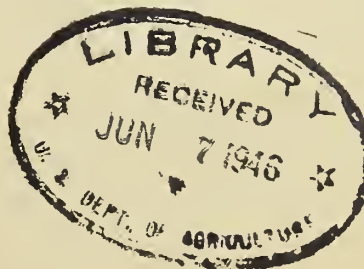
PRECOOLING LOADED CARS OF ITALIAN PRUNES AT MILTON-FREEWATER,
OREGON, AND SHIPPING TESTS TO NEW YORK CITY

August 22 to September 14, 1944

By

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Italian prunes grown in the Milton-Freewater district of Oregon are packed warm and loaded in iced refrigerator cars for shipment to market. For Atlantic Coast markets 30-pound baskets are used. Usually the cars are initially iced sometime during the day or evening prior to loading. Icing platform facilities at the shipping point are inadequate to permit reicing and the loaded cars are moved to Reith, Oregon or Pasco, Washington to be reiced and initially salted. This is usually 6 to 24 hours after loading and frequently 24 to 40 hours after the warm cars are initially iced.

Sometimes the prunes are precooled in the car by the operation of portable bunker fans after 200 pounds of salt has been added to the ice. The fans are rarely operated for longer than 8 hours and, although present facilities do not permit the reicing of cars during precooling, satisfactory deliveries of fruit have usually been made in past years, the fruit becoming over-ripe or decayed in transit only in exceptional instances. Although many receivers request that their shipments be precooled, opinion among shippers is divided as to the necessity or value of present precooling practices. It was to obtain information in regard to this that the present investigation was begun in 1943. Results of last year's work showed that the prunes were only partially cooled to desired shipping temperatures when the bunker fans were operated for 9.5 hours.

OBJECTS OF THE WORK

The principal objectives of this year's studies were: (1) to obtain more information on the need for precooling Italian prunes; (2) to determine the effectiveness of Preco fans in precooling warm loads of Italian prunes and also in cooling such loads in transit when they are not precooled at shipping point; (3) to evaluate the amount of precooling and the transit temperatures in loads of warm fruit shipped in cars when ice bunkers are filled to only 3/4 capacity in accordance with a special O.D.T. rule applied during most of the shipping season (on account of the prevailing shortage of ice); and (4) to obtain further information on the possibility that Italian prunes may be injured by carrying them at low temperatures, as suggested by preliminary storage tests conducted in the laboratory several years ago.

METHODS

For these precooling and shipping tests the Italian prunes were packed in 30-pound baskets which were loaded four layers deep in staggered rows as a solid load. This left the top of the load 38 inches from the ceiling and at a height not particularly unfavorable to cooling, giving plenty of room for air circulation.

Precooling tests: Electric resistance thermometers were placed at the centers of 11 baskets in one end of each car. These packages were located in a centerline position between the car walls as follows:

Top layer: a, doorway; b, quarter-length; c, bunker

Middle (2nd) layer: a, doorway; b, $3/8$ length; c, quarterlength;
d, $1/8$ length; e, bunker

Bottom layer: a, doorway; b, quarterlength; c, bunker

In addition, the temperature of the air blast was taken at a position 6 inches in front of the top bulkhead opening in the fan cars and 6 inches in front of the face of the fan opening in cars precooled with portable fans.

Temperature records were made during the precooling period in all cars used in the shipping tests and in 3 fan cars and 1 standard car not used in shipping tests. The first record of temperatures in all instances was made after the fruit had been loaded but before the fans were operated.

The loads precooled for 8 hours were representative of usual commercial operations in which the salt was thrown on the ice without spudding down. The thorough precooling was closely supervised and given additional service by the investigators in order to lower the fruit temperatures to the desired level. This involved chopping the ice to receive the initial charge of salt, reicing the cars during precooling, and spudding down and otherwise preparing the ice for subsequent additions of salt.

Shipping tests: Four shipping tests were made with 11 cars of fruit billed to New York City via N. P., C.B. & Q. and Erie railroads. A recording thermometer was fastened on a sill under one car of each test to record outside air temperatures in transit. Inside the cars recording thermometers were placed as follows:

Test 1: a, top doorway, center, within a fruit package
b, bottom bunker, center, within a fruit package
c, beneath floor racks

Tests 2, 3, and 4: a, top quarterlength, center, within a fruit package
b, bottom bunker, center, within a fruit package
(only in cars thoroughly precooled)

Comparable test packages for observation at destination were prepared by compositing the fruit before shipment. The packages in test 2 contained fruit of one maturity, considered optimum for mid-season shipment. In tests 3 and 4 the packages were half filled with fruit of "early maturity" and the remainder with prunes of advanced maturity, a separator being used to divide the fruit of the two maturities. Recording thermometers were placed in these containers.

The test packages were recovered in New York City (one in Albany, N. Y.) and records made on firmness (by using a pressure tester with a $5/16$ in. plunger on 20 fruits), percentage of decay, color (percentage of purple color), color of flesh, days to ripen sufficiently for dessert purposes, percentage of decay after ripening and ripening characteristics in packages carried at the lowest temperatures.

Table 1 gives a schedule of all cars used in the precooling studies and shipping tests.

RESULTS

Precooling Tests

The data on precooling are summarized in table 2. Tables 3 to 13 give detailed temperature data on individual cars.

In evaluating the extent of precooling, the average of 11 fruit temperatures per car have been used. Three positions were in the 4th or top layer, 5 in the 2nd or middle layer, and 3 in the first or bottom layer of packages. In some cars the average of temperatures in the top layer after precooling was slightly lower than the average of all positions but in no instances was the difference greater than 3° F.

In fan cars, when 200 lbs. of salt was added to the ice before precooling, and the fans were driven by motors for 10 hours, the fruit was cooled from initial temperatures between 62.2° F. and 65.3° to a range of 48.9° to 51°. When 500 pounds of salt was added (250 pounds at the start of precooling and 250 pounds after 5 hours) the average fruit temperature was reduced from 66.2° to 46.4°. Test D (table 1) was made with bunkers initially filled to 3/4 capacity. A greater amount of cooling was obtained in this car than in those initially iced to full capacity with 200 pounds of salt added and similarly precooled by the attachment of motors to the Preco fans. The more rapid cooling is not readily explained unless possibly by assuming more rapid circulation of air due to less resistance from the smaller amount of ice, or perhaps to differences in car construction, since this particular car was in a different series.

Although these experiments were not planned especially to compare different methods of precooling, enough tests were run to show that motor-driven Preco fans were effective and compared favorably with conventional bunker fans. The amount of cooling done by the latter in standard refrigerator cars under commercial practice when fans were operated 8 hours is shown in tests B-2, I-3, and K-4 of table 2. With average initial fruit temperatures of 64.5°, 65.1°, and 70.4° F. the fruit was cooled to 50.5°, 54.1°, and 59° respectively. The last test was made with ice bunkers filled to 3/4 capacity. Since the weather conditions were quite normal for this season of the year, it may be concluded that the temperatures of these loads were representative of the amount of cooling that can be expected under commercial practice when fans are run a full 8 hours. These results should be compared with those in tests C-2, J-3, and L-4 in which more salt was used and the precooling periods were 13-1/2, 20-1/2, and 19 hours. The average fruit temperatures in these cars after precooling were 40.8°, 44.4°, and 45.6° F., representing temperature reductions of 23.4°, 23°, and 22.8°.

It will be observed in tables 3 to 13 that air blast temperatures usually ranged between 39° and 49° F. during the first 8 hours of precooling and that unless additional ice and salt were furnished, air blast temperatures then started to rise. After reicing and adding more salt, air blast temperatures were then maintained between 31° and 35°. It may be concluded, therefore, that to reduce the temperature of Italian prunes to 40° with bunker fans, it is essential to reice the cars at least once during a precooling period of as long as 20 hours.

The precooling tests in standard cars with ice bunkers filled to only 3/4 capacity (E and K-4) showed that a considerable reduction in fruit temperature was accomplished, approximately as much as when the bunkers were initially filled to capacity and the fans were operated for the same time. However, the transit temperatures in the cars iced to 3/4 capacity were not as satisfactory as in those iced to full capacity. This probably can be explained by the fact that considerable time elapsed between the end of precooling and the first reicing during which the reduced residue of ice in the car after precooling with 3/4 bunker icing was insufficient to preserve the advantage gained by precooling.

Transit Temperatures

Fan Cars: The thermographs placed beneath the floor racks in Car B-1 showed that the fans did not operate after 3-1/2 days. At destination the fans were found to be in an off position. This circumstance precludes a reliable evaluation of the efficiency of fan cars under conditions outlined for this experiment. Thermograph failure at a bottom bunker position in car M-1 (non-precooled), as well as diversion of this car to Detroit, Mich., further reduced the value of the experiment.

The graphs of fruit temperatures given in figure 1 show that it required approximately 3 days for the top layer in the non-precooled load to reach 50° F. and 88 hours to reach 45°. This was longer than was required in the 1943 tests when the fruit and outside air temperatures were somewhat lower.

The precooled load in a fan car reached 50° F. within the first 24 hours and 45° in 88 hours. This is longer than is desirable but the record of air blast temperatures reveals that during the first 3 days the fans were in actual operation only about 24 hours. The slow and intermittent car movement in shipments from the Milton-Freewater district, via Walla Walla and Pasco, Wash., or, as in the 1943 tests, via Reith and Pendleton, Ore., should be taken into consideration when arriving at conclusions as to the salting practice to be used in fan cars.

Standard Cars: Differences in top layer fruit temperatures during transit, when loads were not precooled but were shipped under 5 percent salt; and in cars partially precooled by current commercial practice and shipped under 3 percent salt, or when they were thoroughly precooled, are shown in figure 2. The heavy lines in the graph represent average temperatures of two tests where ice bunkers were filled to capacity. The mean outside temperatures

computed from thermograph readings at 6 hour intervals during the first 8 days were: for full bunker tests, 68°, and for 3/4 bunker tests, 65.7°.

During the precooling period the fruit temperatures in the top layer of cars B-2 and I-3 were reduced to slightly below 50° F. and to below 40° in cars C-2 and J-3 which were precooled more thoroughly. However, this graph shows that following precooling, the top of the load, having been cooled more than the underneath fruit, then became warmer. In the thoroughly precooled loads (cars C-2 and J-3) the fruit temperatures in the top layer, after this readjustment, averaged 42.5° whereas in cars B-2 and I-3, that were commercially precooled for only 8 hours, they averaged 10° higher. This was only 3° lower than the average temperature in the top layer of the non-precooled loads at a corresponding time.

After the period of readjustment the top layers in the thoroughly precooled loads remained at about 42.5° F. whereas in the non-precooled and commercially precooled loads the temperatures were considerably higher but continued to drop slowly. The use of 5 percent salt with the non-precooled loads soon reduced the top layer temperatures so that after the second day they were about the same as in the commercially precooled cars.

Icing to 3/4 bunker capacity: No temperature record was secured in the top layer of the thoroughly precooled load because the thermograph failed. Fruit temperatures in the top layers of non-precooled and commercially precooled loads shipped in cars iced to 3/4 bunker capacity are shown by light, broken lines in figure 2. In the car commercially precooled for 8 hours, 5 days elapsed before the top fruit temperature reached 50° F. and 8 days for cooling to 45°. The non-precooled load had still higher temperatures. In both cars the temperatures were dangerously high and, had rhizopus rot been prevalent, these loads provided conditions for its much more rapid growth and spread than in the loads under full bunker ice, even when the latter were not precooled.

Condition of Fruit at New York

Records taken on the condition of fruit in the test packages at different positions in the cars are summarized in table 14. The differences in dessert quality recorded in table 14 were in no instance very pronounced and were related primarily to the degree of ripeness of the fruit at the time of observation. There was no indication that any of the fruit would not have ripened with excellent quality if the fruit had been held longer before being inspected. From these results the following deductions are made as to the effects of precooling on the condition of the fruit after arrival at destination:

1. Non-precooled fruit shipped under standard refrigeration with 5 percent salt, and fruit commercially precooled for only 8 hours and shipped under standard refrigeration with 3 percent salt: There was no significant difference with respect to flesh color, percentage of decay, or time to become eating ripe. The precooled fruit generally had a little less purple color and was slightly firmer at time of arrival but the difference was not great.

2. Thoroughly precooled fruit shipped under standard refrigeration with 3 percent salt: Firmer, with much less purple color upon arrival and, in the instance of 3/4 bunker icing, with less decay than non-precooled fruit or that which was commercially precooled for only 8 hours. The thoroughly precooled fruit required from 3 to 4 days at 65° to 70° F. after arrival in New York to acquire desirable purple color and to ripen to good dessert quality.

3. Fruit under 3/4 bunker icing: Except when the fruit was thoroughly precooled it arrived eating ripe, or over-ripe, and had to be moved into consumption at once; decay, while not serious, generally had a greater start than in cars iced to capacity.

4. Picking maturity: Fruit picked at an advanced stage of maturity carried well but required quicker sale and distribution than fruit picked when less mature. Generally this riper fruit had better dessert quality than that which was less mature when picked.

5. Low temperature injury: Test packages carried at the cold bottom bunker position in thoroughly precooled loads ripened normally with no sign of mealiness or tissue breakdown that were previously noted to result from storing Italian prunes immediately after picking at temperatures below 36° F. As shown in table 15, thermograph records made in test packages at these positions in the car indicate that test fruit temperatures were above the probable critical temperature zone (34° to 36° F.) for the first 48 hours after loading. The fruit was picked during the afternoon prior to loading, thus giving a period of approximately 60 hours between picking and the time when the fruit was cooled to its low temperature. It is possible that this period of delay was long enough to avoid the low temperature injury observed earlier when freshly harvested prunes were stored immediately at 34°-36°.

DISCUSSION

During 1944, when the incidence of decay was light and when an active market caused Italian prunes from the Milton-Freewater district to move rapidly into consumption immediately after arrival in terminal markets, the benefits from precooling did not justify the cost. However, had the fruit been more subject to decay or had the markets been so congested that cars were not unloaded for several days, the situation might have been different. The fruit in the non-precooled cars, as well as that in the loads commercially precooled for only 8 hours, arrived at an advanced stage of ripeness that ordinarily would have been considered unsatisfactory.

Conditions that may cause "bad order" deliveries: The inspections in New York revealed that in the few decayed fruits found in the test packages blue mold rot (Penicillium sp) and rhizopus rot (Rhizopus sp) predominated. In cars with higher temperatures the decay was advanced. Rhizopus makes practically no growth at temperatures below 45° F., but at higher temperatures it spreads from one fruit to another quite rapidly and, once it has a start, results in leaking masses of decayed fruit that literally "run out of the packages". The transit temperatures in the non-precooled or poorly precooled loads, more especially in those shipped under 3/4 icing, were such that under different conditions of growth and harvesting the shipments might have arrived badly affected with decay and in very bad order.

The thoroughly precooled loads, on the other hand, arrived much firmer and with a margin of storage life that would have permitted distribution without loss over a much longer time. The transit temperatures in these cars were such that rhizopus rot could have made but slow progress.

Requirements of thorough precooling: The experimental work has thus far demonstrated that to precool loads satisfactorily it is necessary to have a longer precooling time than 8 hours and that the cars should be reiced during the precooling period with larger additions of salt, preferably 250 pounds at the start of precooling and 250 pounds five to eight hours later, when the cars are reiced. To do this in the Milton-Freewater district would require considerable capital investment for icing platforms, ice supplies, precooling tracks and accessories.

Alternative precautions: The experience of the shippers and the results of these investigations have shown that ordinarily Italian prunes, unless well advanced in maturity, can be shipped to distant markets with safety under standard refrigeration with 5 percent salt added and without thorough precooling. It seems probable also that thorough precooling would not be necessary for riper fruit being shipped to less distant markets. Therefore, it does not seem that the capital investment required for thorough precooling facilities would be justified for the small fraction of the shipments needing thorough precooling in normal years or to meet exigencies such as those in 1944 resulting from an ice shortage.

When the fruit is in weak condition or must move to distant markets under 3/4 bunker icing, thorough precooling for 18-20 hours will probably be needed to get the temperature of the load down to a safe range. When such thorough precooling cannot be done, the following recommendations are made for the handling of the shipments:

1. Precool the loads for 10 hours or more, using 250 pounds of salt at the start of precooling and 250 pounds after 5 hours. Spud down the ice when adding salt to give a good mixture with the ice.

2. Facilitate the movement of cars after precooling and provide for prompt reicing.

3. Ship precooled loads in standard cars under standard refrigeration with 5 percent salt instead of 3 percent salt.

4. Ship precooled loads in fan cars under standard refrigeration with 200 pounds of salt added at the first reicing station.

5. With non-precooled loads in fan cars, add 500 pounds of salt to the ice shortly before departure from shipping point and ship under standard refrigeration with 200 pounds of salt added at the first reicing station.

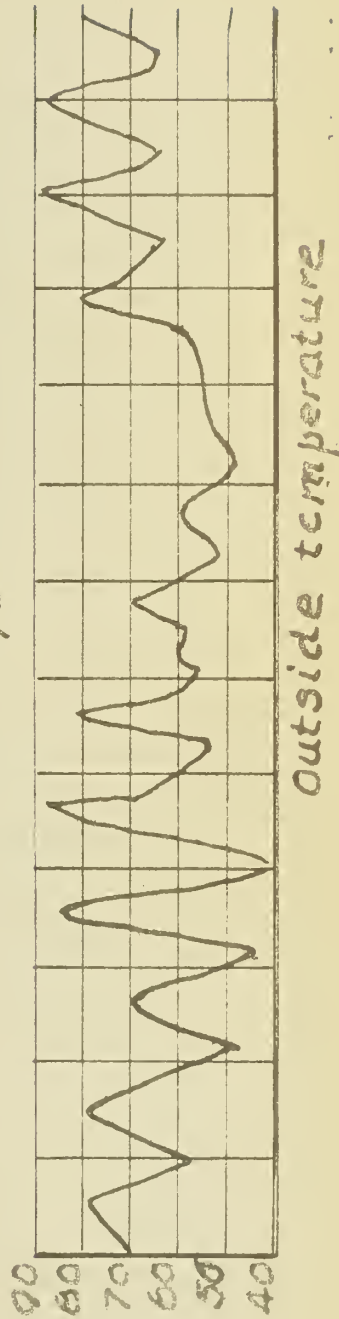
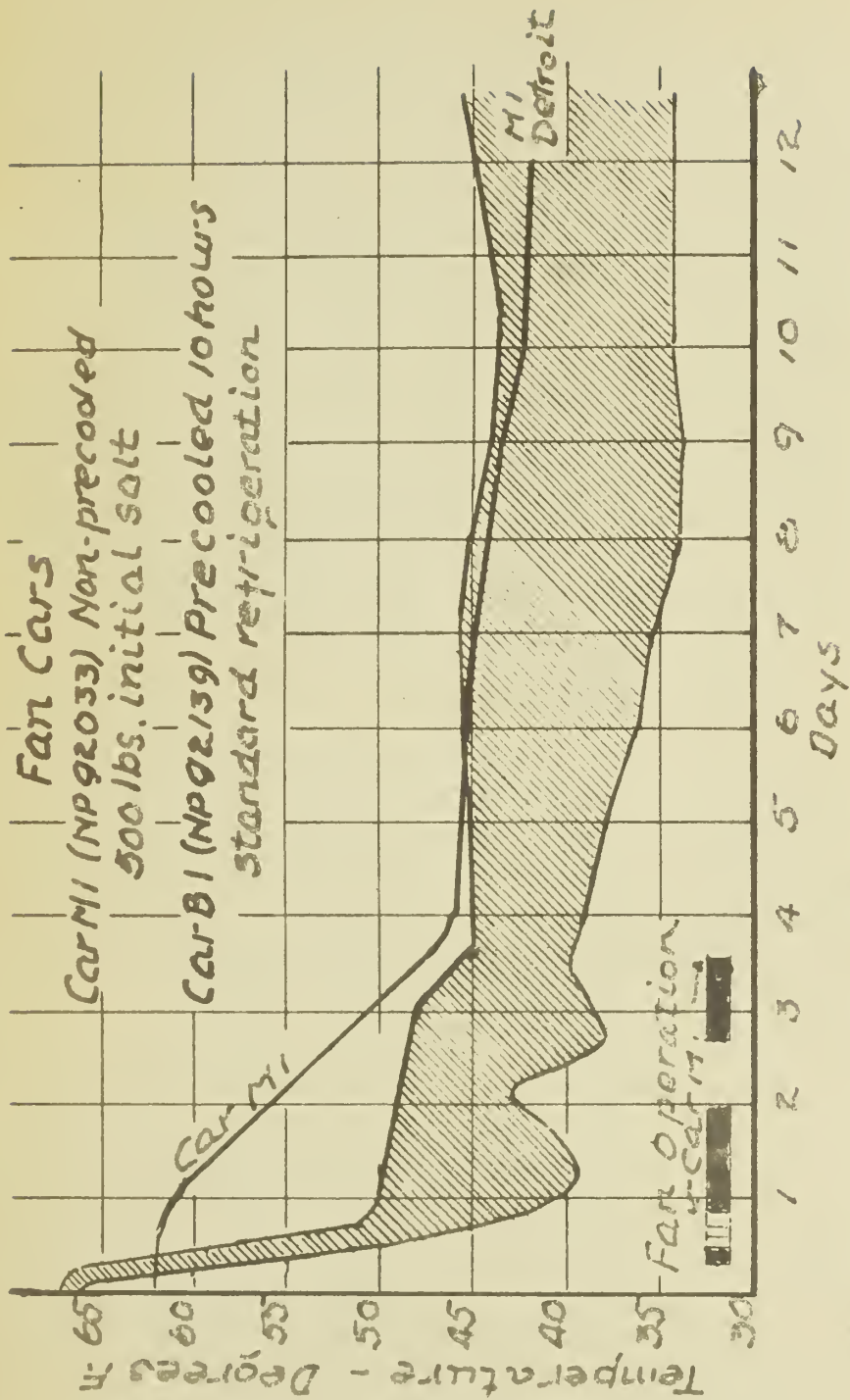
6. When using fan cars be sure that the bill of lading carries the notation "keep fans in 'on' position", thus placing the responsibility for their continued operation on the carrier. Without this definite instruction

the fans will be taken out of operation enroute. To make doubly certain that bills of lading on all fan cars carry this notation, the shipping foreman should receive definite instructions to report to the billing clerk the numbers of all such cars. The billing clerk should have ready access to a list of all fan cars on all lines and should be instructed to check the list before billing the car.

Records of transit temperatures in the shipping tests in 1943 and 1944 (see record of M-1, figure 1) show that non-precooled loads in fan cars, where 500 pounds of salt was added to the ice immediately after loading, were slow in cooling. This was because the cars were standing for much of the time before they reached the main line, and the effect of the salt was largely lost before the action of the fans could utilize the refrigeration to cool the tops of the loads. In view of this slow movement of cars from the Milton-Freewater district through the gateways to the main line railroads, it is much more preferable to operate the fans by motors from the time of loading until they leave the point of origin so that the initial charge of salt (500 pounds) can be utilized as effectively as possible for the prompt cooling of the upper part of the load.

ACKNOWLEDGMENTS

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$\frac{3}{4}$ Bunker Icings

- Car 34 Non-precooled - 5% Salt
- Car K4 Precooled 8 hrs. - 3% Salt

Full Bunker Icings: Averages of

- Cars N2-R3 Non-precooled - 5% Salt
- Cars B2-I3 Precooled 8 hrs. - 3% Salt
- +++ Cars C2-J3 Precooled 18½ - 20½ hrs. - 3% Salt

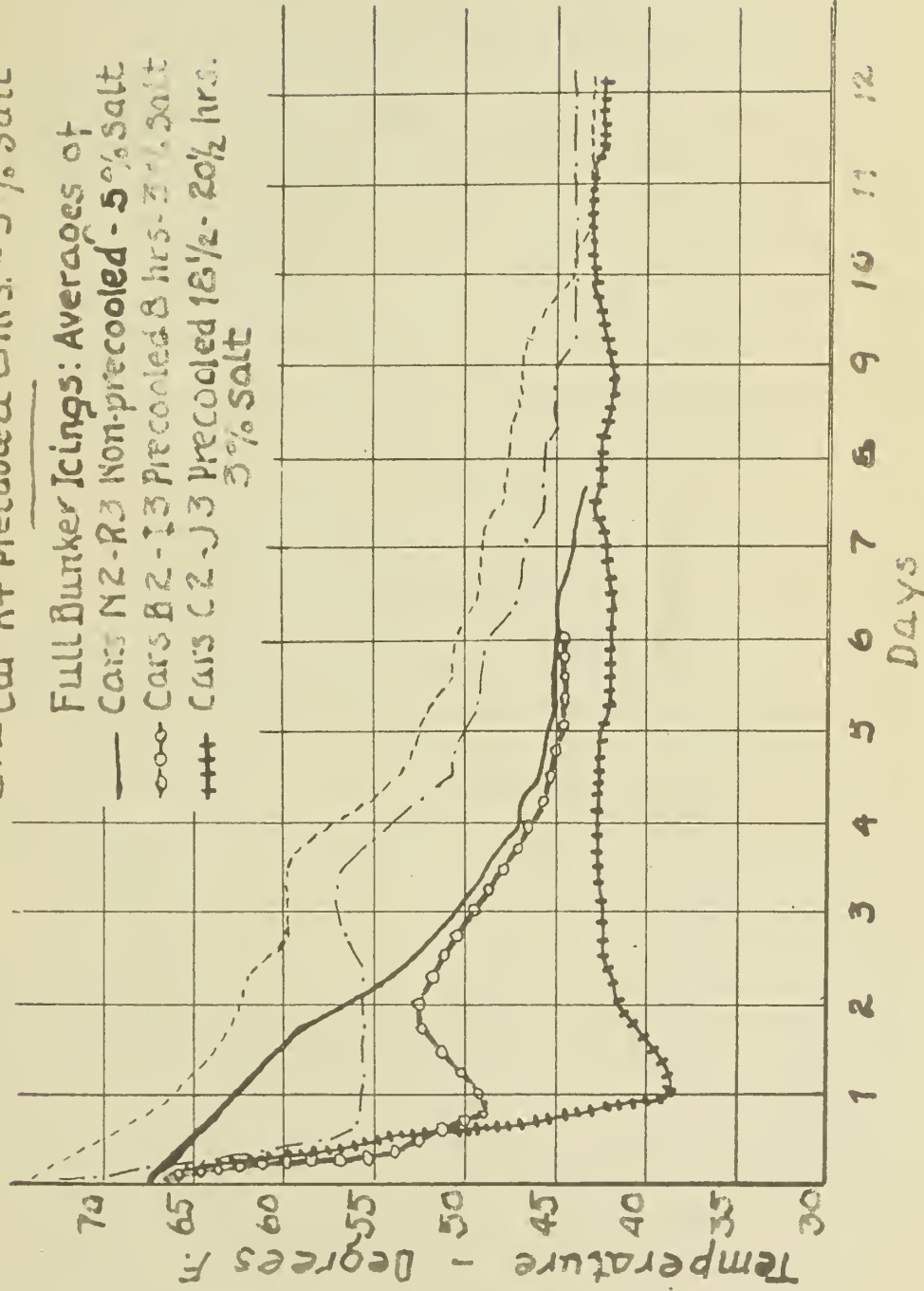


Figure 2. Fruit temperatures at a top layer quarter-length position in precooled and non-precooled loads of Italian prunes shipped in standard refrigerator cars. Heavy lines represent average temperatures from two tests with ice bunkers filled to capacity. Light broken lines represent temperatures from one test when ice bunkers were filled to $\frac{3}{4}$ capacity. Mean outside temperatures during first 8 days: full bunker tests, 68° F.; $\frac{3}{4}$ bunker test, 65.7°.

Table 1. Schedule of precooling tests made at Milton-Freewater, Oregon, and shipping tests from that point to New York City, 1944

Date	Number	Car Type	Symbol	Ice Bunkers	Precooling treatment	Shipping test	Transit treatment
8-22	NP 92069	Fan	A	Full	Preco motors 10 hrs.	-	500 lbs. salt-Std. refrig. <u>1</u> / Std. refrig.
8-23	NP 92033	Fan	M 1	Full	None	1	
8-23	NP 92139	Fan	B 1	Full	Preco motors 10 hrs.	1	
8-24	NP 92028	Fan	C	Full	Preco motors 10 hrs.	-	
8-25	PFE 76285	Fan	D	3/4 full	Preco motors 10 hrs.	-	
8-25	PFE 71809	Std.	E	3/4 full	Bunker fan 10 hrs.	-	
8-26	NP 90499	Std.	N 2	Full	None	2	Std. refrig. 5% salt
8-26	NP 90215	Std.	B 2	Full	Commercial 8 hrs.	2	Std. refrig. 3% salt
8-26	NP 90094	Std.	C 2	Full	Thorough 18-1/2 hrs	2	Std. refrig. 3% salt
8-29	NP 90553	Std.	R 3	Full	None	3	Std. refrig. 5% salt
8-29	NP 90446	Std.	I 3	Full	Commercial 8 hrs.	3	Std. refrig. 3% salt
8-29	NP 90256	Std.	J 3	Full	Thorough 20-1/2 hrs.	3	Std. refrig. 3% salt
8-31	NP 93802	Std.	S 4	3/4 full	None	4	3/4 bunker icing - 5% salt <u>2</u> / 3/4 bunker icing - 3% salt
8-31	NP 93537	Std.	K 4	3/4 full	Commercial 8 hrs.	4	3/4 bunker icing - 3% salt
8-31	NP 93083	Std.	L 4	3/4 full	Thorough 19 hrs.	4	3/4 bunker icing - 3% salt

1/ Diverted to Detroit, Michigan

2/ Diverted to Albany, New York

3/ Initially iced to 3/4 bunker capacity but reiced to capacity during precooling
as with other thoroughly precooled loads

Table 2. Summarized data of precooling. Milton-Freewater, Oregon. 1944

Date	Car No.	Car Symbol	Load		Ice added	Salt used	Precooling equipment	Outside temperature	Hours-pre-cooled	Average fruit temperature ^{3/}		
			Bskts.	Pounds						Start	Close	Drop
					Lbs.	Lbs.		°F.		°F.	°F.	°F.
8-22	NP 92069	A	868	26040	None	200	Preco	76-87	10	65.3	51.0	14.3
8-23	NP 92139	B 1	896	26380	None	500 ^{2/}	Preco	69-85	10	66.2	46.4	19.8
8-24	NP 92028	C	896	26380	None	200	Preco	62-76	10	64.2	49.5	14.7
8-25	PFE 76285	D	868	26040	1 ^{1/}	200	Preco	64-77	10	63.4	45.6	17.8
8-25	PFE 71809	E	880	26400	1 ^{1/}	200	4 blade fans	64-76	10	62.2	48.9	13.3
8-26	NP 90215	B 2	880	26400	None	200	4 blade fans	74-85	8	64.5	50.5	14.0
8-26	NP 90094	C 2	896	26380	4200	500 ^{2/}	2 blade fans	61-85	13-1/2	64.2	40.8	23.4
8-29	NP 90446	I 3	896	26380	None	200	4 blade fans	73-85	8	65.1	54.1	11.0
8-29	NP 90256	J 3	880	26400	4500	500 ^{2/}	4 blade fans	52-85	20-1/2	67.4	44.4	23.0
8-31	NP 93537	K 4	896	26380	None ^{1/}	200	2 blade fans	68-82	8	70.4	59.0	11.4
8-31	NP 93083	L 4	882	26460	5500 ^{1/}	625 ^{2/}	4 blade fans	60-82	19	67.4	45.6	22.8

^{1/} Car initially iced to 3/4 bunker capacity

^{2/} For salt not added at start of precooling see temperature data table for each car.

^{3/} Average of 11 positions in one end of each car.

Table 3. Temperatures during precooling. Car No. NP 92069, Preco fan car precooled by operating Preco motors; initially iced to full capacity; 200 lbs. salt added at start of precooling

868 baskets Italian prunes. Freewater, Oregon, August 22, 1944

Time	Hours run	Out-side temp. °F.	Air blast °F.	Fruit temperatures							
				TOP				MIDDLE			
				Door °F.	Quart °F.	Bunk °F.	Door °F.	3/8 °F.	Quart °F.	1/8 °F.	Bunk °F.
10:45A	Start	78	63.6	64.5	60.4	68.5	67.6	69.5	61.2	68.0	66.0
11:45A	1	78	42.9	62.2	56.4	66.8	64.3	65.2	56.4	64.0	64.1
12:45P	2	79.5	42.6	61.0	54.4	65.5	61.8	62.2	53.9	63.0	62.9
2:45P	4	84.5	41.6	58.8	51.2	64.1	58.7	58.8	51.4	58.7	61.2
3:45P	5	85	41.8	57.8	50.3	62.9	57.5	57.6	50.6	57.8	60.2
4:45P	6	87	41.2	56.7	48.7	61.9	55.7	55.5	49.2	56.5	59.4
5:45P	7	86	42.3	55.3	48.1	60.8	54.3	54.6	48.4	55.8	58.6
7:45P	9	76	42.4	53.0	45.9	58.7	52.1	52.0	46.9	53.0	57.0
8:45P	10	76	42.6	51.6	44.9	57.6	50.5	51.0	46.2	52.0	55.9
				BOTTOM							
				Door °F.	Quart °F.	Bunk °F.	Door °F.				
				63.8	61.0	66.0	63.8				
				59.6	57.4	64.1	59.6				
				56.2	56.7	62.9	56.2				
				54.9	54.6	61.2	54.9				
				54.0	53.5	60.2	54.0				
				52.4	52.1	59.4	52.4				
				51.5	51.4	58.6	51.5				
				49.9	49.4	57.0	49.9				
				49.2	48.6	55.9	49.2				

Table 4. Temperatures during precooling. Car No. NP 92139, Preco fan car precooled by operating Preco motors; initially iced to full capacity; 250 lbs. salt added at start of precooling and 250 lbs. added after 5 hrs.

896 baskets Italian prunes. Freewater, Oregon, August 23, 1914

Time	Hours run	Out- side temp. °F.	Air blast °F.	Fruit temperatures													
				TOP						MIDDLE						BOTTOM	
				Door °F.	Quart °F.	Bunk °F.	Door °F.	3/8 °F.	Quart °F.	1/8 °F.	Bunk °F.	Door °F.	Quart °F.	Bunk °F.			
10:30A	Start	69	66.4	65.0	63.4	68.5	62.8	61.2	70.9	72.4	65.7	62.7	70.8	64.4			
11:30A	1	75	41.6	63.2	56.8	66.5	58.9	57.8	61.8	59.0	63.8	58.6	62.7	62.9			
12:30P	2	75	40.9	62.0	53.4	65.3	57.1	56.3	58.2	54.5	63.1	56.9	59.0	62.0			
1:30P	3	78	40.8	60.7	51.1	63.7	55.3	54.2	55.4	51.5	61.9	55.2	55.7	60.4			
2:30P	4	83	40.3	59.5	49.2	62.5	53.1	53.0	52.2	49.3	60.7	53.5	53.0	59.1			
3:30P	5	83	39.1	58.0	47.8	61.3	51.9	51.4	50.7	47.6	58.9	52.4	51.1	58.3			
				250 lbs.	salt added at 3:30 P.M.												
4:30P	6	82	34.6	56.3	45.4	59.8	50.1	50.1	48.2	45.5	57.9	50.7	48.8	57.2			
5:30P	7	85	33.6	54.3	43.3	58.0	48.7	48.6	45.9	43.3	57.7	49.2	46.5	55.9			
6:30P	8	84	34.2	52.5	41.9	57.0	47.4	47.3	43.9	42.2	56.4	48.0	44.7	54.5			
8:30P	10	77.5	34.8	50.0	40.2	52.9	45.0	44.7	41.7	40.4	54.0	46.2	42.5	52.5			

Table 5. Temperatures during precooling. Car No. NP 92028, Preco fan car precooled by operating Preco motors; initially iced to full capacity, 200 lbs. salt added at start of precooling

896 baskets Italian prunes, Freewater, Oregon August 24, 1944

Time	Hours run	Out-side temp. °F.	Air blast °F.	Fruit temperatures											
				TOP			MIDDLE					BOTTOM			
				Door °F.	Quart °F.	Bunk °F.	Door °F.	3/8 °F.	Quart °F.	1/8 °F.	Bunk °F.	Door °F.	Quart °F.	Bunk °F.	
10:30A	Start	62	63.2	60.0	61.5	68.1	60.3	61.3	71.1	70.4	62.4	60.7	67.6	63.2	
11:30A	1	67	40.9	57.7	57.6	66.9	55.8	56.6	62.7	65.5	61.3	58.0	61.5	62.4	
12:30P	2	72	40.9	55.8	54.5	66.1	53.8	54.3	59.2	63.3	60.7	56.7	58.6	61.3	
1:30P	3	74	39.5	54.5	52.1	65.0	52.1	52.4	56.7	61.0	59.4	55.7	56.5	60.6	
2:30P	4	74	38.9	53.2	50.2	63.8	50.8	51.3	54.4	59.4	58.4	54.7	54.1	59.5	
4:30P	6	76	41.8	50.9	48.1	61.5	48.8	49.4	51.7	56.2	56.9	52.9	51.5	57.7	
Worked in car 30 minutes															
5:30P	7	76	40.1	49.5	47.1	60.0	47.4	48.0	49.8	54.0	55.7	51.6	50.2	56.6	
7:00P	8-1/2	72	41.0	48.2	46.4	58.3	46.7	47.0	48.9	52.3	54.4	50.7	48.8	55.2	
8:30P	10	67	41.0	47.0	45.2	57.1	45.9	46.2	47.6	50.7	53.4	49.7	47.6	54.2	

Table 6. Temperatures during precooling. Car No. PFE 76285. Preco fan car precooled by operating Preco motors; initially iced to $3/4$ bunker capacity; 200 lbs. salt added at start of precooling

868 baskets Italian prunes. Freewater, Oregon, August 25, 1944

Fruit temperatures														
Time	Hours run	Out-side temp. °F.	TOP				MIDDLE				BOTTOM			
			Air blast °F.	Door °F.	Quart °F.	Bunk °F.	Door °F.	3/8 °F.	Quart °F.	1/8 °F.	Bunk °F.	Door °F.	Quart °F.	Bunk °F.
11:00A	Start	71	59.5	66.7	63.9	64.2	63.7	62.5	64.2	63.0	62.6	63.2	62.8	60.6
12:00P	1	74	40.6	62.5	56.4	58.5	59.3	60.5	57.5	58.2	59.0	57.7	59.5	57.9
2:00P	3	76	38.8	58.2	49.1	52.6	54.1	58.3	52.0	54.0	54.4	51.6	55.6	54.7
4:00P	5	77	39.0	54.2	44.3	48.9	50.2	56.2	48.4	51.0	51.7	48.6	52.7	51.7
6:00P	7	76	39.2	51.2	41.9	45.9	47.9	53.7	45.5	48.7	49.4	46.0	50.0	49.7
8:00P	9	69	39.3	48.7	40.4	43.6	46.1	52.0	44.2	47.0	47.6	44.2	48.2	47
9:00P	10	64	39.9	47.7	40.1	43.1	45.4	51.2	43.8	46.3	46.9	43.6	47.2	46.0

Table 7. Temperatures during precooling. Car No. PFE 71800, standard car precooled with 14-blade fans; initially iced to 3/4 bunker capacity; 200 lbs. salt added at start of precooling

380 baskets Italian prunes, Freewater, Oregon, August 25, 1944

Time	Hours run	Out-side temp. °F.	Air blast °F.	Fruit temperatures											
				TOP			MIDDLE				BOTTOM				
				Door °F.	Quart °F.	Bunk °F.	Door °F.	3/8 °F.	Quart °F.	1/8 °F.	Bunk °F.	Door °F.	Quart °F.	Bunk °F.	
11:30A	Start	74	64.3	64.5	63.6	64.1	60.3	61.1	62.4	62.3	61.3	59.9	63.3	60.9	
12:30P	1	74	39.7	63.7	58.2	59.1	56.3	57.5	60.0	61.0	58.8	57.5	61.7	58.2	
1:30P	2	76	39.0	62.3	53.6	56.8	53.4	54.3	58.0	59.8	56.7	55.2	60.4	55.1	
2:30P	3	76	39.0	61.5	51.4	54.8	52.1	52.6	57.0	59.1	55.2	54.1	59.5	53.1	
4:30P	5	76	39.7	59.5	47.4	51.5	49.6	49.8	54.5	56.3	52.4	51.6	57.3	50.1	
6:30P	7	75	40.6	57.3	45.2	49.5	48.1	48.2	52.8	55.2	51.2	49.8	55.4	48.2	
8:30P	9	64	41.4	55.3	44.5	48.1	47.1	47.4	52.0	53.8	49.0	48.7	53.7	47.3	
9:30P	10	64	41.4	54.1	44.2	47.0	46.4	46.7	51.2	52.5	48.2	48.3	53.0	46.5	

Table 3. Temperatures during precooling. Car No. NP 90215. Standard car precooled with 4-blade fans; initially iced to full capacity; 200 lbs. salt added at start of precooling

880 baskets Italian prunes, Freewater, Oregon, August 26, 1944

Time	Hours run	Out- side temp. °F.	Air blast °F.	Fruit temperatures									
				TOP			MIDDLE			BOTTOM			
				Door °F.	Quart °F.	Bunk °F.	Door °F.	Quart °F.	1/8 °F.	Bunk °F.	Door °F.	Quart °F.	Bunk °F.
2:00P	Start	80	51.7	65.3	63.5	66.5	64.6	64.5	65.0	64.5	64.7	65.8	61.1
3:00	1	85	39.7	64.8	51.5	62.5	59.3	58.2	61.3	63.8	60.5	61.2	54.0
5:00	3	84	39.4	63.1	48.4	58.7	56.0	53.4	59.1	62.5	56.4	58.0	49.8
6:00	4	84	39.4	62.1	45.3	56.8	54.2	51.5	57.3	61.7	54.4	56.6	48.0
7:00	5	79	39.4	60.7	43.5	54.5	52.8	50.0	55.6	60.9	52.6	55.0	46.5
9:00	7	74	40.0	58.7	42.3	50.8	50.8	48.0	52.8	58.8	49.8	53.0	45.0
10:00	8	74	40.7	57.3	42.3	49.5	49.8	47.5	51.5	57.7	48.7	52.2	45.0

Table 9. Temperatures during precooling. Car No. NP 90094, standard car precooled with 2-blade fans. (Fans ran reversed until 3:15 P.M.) Initially iced to full capacity; 250 lbs. salt added at start of precooling; reiced with 4200 lbs. ice; 250 lbs. salt added after 8 hours.

896 baskets Italian prunes, Freewater, Oregon, August 26, 1944

Time	Hours run	Out-side temp. °F.	Air blast °F.	Fruit temperatures											
				TOP			MIDDLE						BOTTOM		
				Door °F.	Quart °F.	Bunk °F.	Door °F.	3/3 °F.	Quart °F.	1/8 °F.	Bunk °F.	Door °F.	Quart °F.	Bunk °F.	
2:00P	Start	80	66.1	66.5	64.4	65.3	65.6	64.0	65.5	63.5	66.8	63.9	62.7	57.7	
3:00	1	85	55.8	65.3	63.1	61.6	64.3	63.0	63.9	62.0	65.0	60.8	60.9	54.7	
5:00	3	84	41.4	57.0	59.5	59.3	59.8	58.2	61.7	61.5	59.4	55.0	58.4	50.1	
6:00	4	84	41.6	54.0	56.9	57.8	57.6	55.1	60.5	60.0	57.2	53.2	57.3	48.7	
7:00	5	79	41.8	52.0	55.0	56.4	56.2	54.5	58.2	58.7	55.4	51.6	56.1	47.7	
9:00	7	74	42.1	49.6	51.6	53.9	53.7	52.2	57.7	57.4	52.6	49.5	54.5	46.7	
10:00	8	74	42.6	48.6	50.4	52.5	52.8	51.2	56.6	56.4	51.9	48.7	53.6	45.9	
Disconnected for re-icing 10:30 P.M. to 2:00 A.M.															
2:00A	8-1/2	70	38.2	48.6	48.4	50.9	52.6	50.8	54.9	54.9	51.6	49.7	53.0	46.0	
4:00	10-1/2	68	34.4	43.7	45.1	47.5	48.4	46.3	52.5	54.0	48.4	45.0	50.0	42.5	
6:00	12-1/2	61	33.9	42.2	42.9	45.1	46.1	44.0	50.7	53.0	45.9	43.0	48.3	40.7	
8:00	14-1/2	72	33.6	40.3	40.4	43.0	43.7	42.0	48.7	51.3	43.9	40.9	46.5	39.2	
10:00	16-1/2	76	33.9	38.7	39.3	41.3	42.1	40.6	46.9	49.5	41.9	39.7	44.6	37.9	
12:00P	18-1/2	82	35.0	38.0	37.9	39.8	40.8	39.5	44.8	48.4	40.9	38.4	43.0	37.2	

Table 10. Temperatures during precooling. Car No. NP 90446. Standard car precooled with 4-blade fans; initially iced to full capacity; 200 lbs. salt added at start of precooling.

806 baskets Italian prunes, Freewater, Oregon, August 29, 1944

Time	Hours run	Out-side temp. °F.	Air blast °F.	Fruit temperatures											
				TOP			MIDDLE						BOTTOM		
				Door °F.	Quart °F.	Bunk °F.	Door °F.	3/8 °F.	Quart °F.	1/8 °F.	Bunk °F.	Door °F.	Quart °F.	Bunk °F.	
12:30P	Start	78	67.3	66.3	68.9	65.1	65.8	64.2	63.8	65.7	66.2	66.6	62.6	61.3	
1:30	1	81	41.4	65.0	63.7	61.3	62.3	60.7	60.5	64.4	59.7	61.2	60.3	58.3	
2:30	2	82	40.9	64.0	61.2	59.1	60.4	58.5	60.6	63.9	57.4	60.7	58.6	56.7	
3:30	3	85	41.1	63.0	58.9	57.3	58.8	57.3	59.9	63.4	55.4	58.9	57.4	55.2	
4:30	4	83	41.8	62.0	57.2	55.6	57.6	55.5	59.4	62.5	53.8	58.2	56.7	54.1	
6:30	6	80	43.1	60.0	53.7	53.1	55.6	54.0	57.9	61.5	51.7	55.9	55.7	52.2	
8:30	8	73	43.6	58.4	51.5	51.3	54.0	52.7	56.8	59.9	51.0	54.5	54.3	51.1	

Table 11. Temperatures during precooling. Car No. NP 90256, standard car precooled with 4-blade fans; initially iced to full capacity; 250 lbs. salt added at start of precooling; reiced with 4500 lbs. ice; 250 lbs. salt added after 11 hours.

880 baskets Italian prunes, Freewater, Oregon, August 29, 1944

Time	Hours run	Out-side temp. °F.	Fruit temperature											
			Air blast °F.	TOP			MIDDLE				BOTTOM			
				Door °F.	Quart °F.	Bunk °F.	Door °F.	3/8 °F.	Quart °F.	1/8 °F.	Bunk °F.	Door °F.	Quart °F.	Bunk °F.
9:30A	Start	72	63.2	68.5	71.1	65.9	65.4	66.7	66.7	64.5	67.5	69.7	66.7	68.2
10:30	1	74	40.3	67.8	61.2	63.0	63.1	63.6	61.5	62.5	64.8	68.7	64.4	62.8
11:30	2	76	37.5	67.1	56.5	62.1	61.7	61.7	58.9	61.5	63.6	67.7	63.2	60.5
12:30P	3	79	38.7	66.2	53.2	61.1	60.6	60.0	57.1	60.5	62.0	66.5	62.0	58.3
1:30	4	81	40.0	65.3	52.2	57.9	59.5	58.7	56.0	59.9	60.6	65.8	61.2	56.8
2:30	5	82	40.7	64.0	50.5	57.1	58.5	57.6	54.6	59.1	58.9	64.8	60.2	54.5
4:30	7	83	42.2	61.7	48.0	54.0	57.0	55.2	52.6	57.5	55.4	62.5	58.5	53.1
6:30	9	80	42.7	59.5	46.7	51.9	55.3	53.7	51.5	56.1	53.2	60.7	57.5	51.5
8:30	11	73	43.2	57.9	45.6	50.5	53.7	52.5	51.0	54.5	51.2	59.0	56.0	50.4
Disconnected 8:30 P.M. - Reicing -- Reconnected 9:00 P.M.														
11:00P	13	72	36.2	55.1	43.0	48.2	51.8	50.4	48.4	52.5	49.0	57.2	53.8	48.0
1:00	15	70	35.7	53.2	41.2	46.4	49.9	48.8	46.4	50.6	47.2	55.1	52.3	46.5
2:30	16-1/2	66	34.2	51.9	40.0	44.9	48.8	47.8	45.3	49.6	45.9	54.0	51.2	44.7
4:30	18-1/2	62	33.3	50.0	38.6	42.9	47.2	45.8	43.7	48.1	44.2	51.9	49.6	42.9
6:30	20-1/2	58	33.0	48.4	37.2	41.5	45.8	44.2	42.2	46.5	42.8	50.7	48.0	41.5

Table 12. Temperatures during precooling. Car No. NP 93537, standard car precooled with 2-blade fans; initially iced to $3/4$ bunker capacity; 200 lbs. salt added at start of precooling

896 baskets Italian prunes, Freewater, Oregon, August 31, 1944

Time	Hours run	Out-side temp.	Air blast	Fruit temperatures											
				TOP			MIDDLE				BOTTOM				
				Door	Quart	Bunk	Door	3/8	Quart	1/8	Bunk	Door	Quart	Bunk	
		°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
10:45A 11:45 1:15P 2:45	Start	72	60.8	73.9	71.4	70.5	69.7	73.5	68.7	70.0	70.6	69.5	69.0		
	1	78	47.3	70.4	66.2	65.8	66.4	70.6	67.0	68.6	66.7	66.5	64.9		
	2-1/2	78	48.9	67.0	62.8	62.3	64.6	68.5	65.7	67.4	64.6	64.6	62.5		
	4	82	49.2	64.0	63.4	59.7	62.9	66.6	63.7	66.0	63.4	63.2	60.6		
	Disconnected 2:45 P.M.			Reconnected 4:00 P.M.											
6:00	6	74	49.8	60.4	58.9	57.1	60.8	63.6	61.7	64.7	61.2	61.0	58.0		
8:00	8	68	49.6	58.0	55.4	54.9	59.3	61.7	60.2	63.0	59.6	59.5	56.4		

Table 13. Temperatures during precooling. Car No. NP 93033, standard car precooled with 4-blade fans; initially iced to $\frac{3}{4}$ bunker capacity; 200 lbs. salt added at start of precooling; 5500 lbs. ice and 250 lbs. salt added after 5-1/2 hours; 50 lbs. salt added after 9-1/2 hours; 125 lbs. salt added after 13-1/2 hours.

832 baskets Italian prunes, Freewater, Oregon, August 31, 1944

Time	Hours run	Out-side temp. °F.	Air blast °F.	TOP				MIDDLE				BOTTOM			
				Door °F.	Quart °F.	Bunk °F.	Door °F.	3/8 °F.	Quart °F.	1/8 °F.	Bunk °F.	Door °F.	Quart °F.	Bunk °F.	
9:15A	Start	71	65.3	66.5	73.0	67.3	66.6	66.6	67.8	65.4	67.3	66.5	68.8	65.5	65.5
10:15A	1	72	43.1	64.8	69.5	66.7	65.4	65.2	67.1	64.5	65.5	64.8	68.8	61.1	61.1
11:15A	2	75	42.0	63.7	67.6	66.2	63.2	64.2	66.6	64.0	64.2	63.8	67.1	57.5	57.5
12:15P	3	75	40.0	62.7	65.5	65.5	62.3	63.4	66.0	63.4	63.1	63.0	66.3	55.0	55.0
1:15P	4	73	40.4	61.7	63.3	64.5	61.0	62.6	65.7	62.8	61.6	62.1	65.8	53.2	53.2
2:45P	5-1/2	82	42.4	59.5	60.3	62.9	59.2	61.4	64.5	62.0	59.7	60.8	64.4	51.8	51.8
Disconnected 2:45 P.M. for re-icing. Reconnected at 4:00 P.M.															
6:00P	7-1/2	74	36.3	57.0	55.0	59.5	56.3	58.8	62.5	60.5	56.9	57.7	62.0	48.2	48.2
8:00P	9-1/2	63	36.1	53.8	51.7	57.5	53.4	56.7	60.3	58.8	54.4	55.2	60.2	46.0	46.0
10:00P	11-1/2	66	35.2	50.8	48.7	55.0	51.0	54.4	58.5	57.1	52.4	53.2	58.2	44.0	44.0
12:00A	13-1/2	64	35.2	48.5	46.5	53.0	48.8	52.2	57.0	55.8	50.2	51.2	56.3	42.5	42.5
1:00A	14-1/2	62	31.5	47.2	44.7	52.0	47.8	51.4	56.0	54.7	49.2	50.0	55.3	41.0	41.0
3:00A	16-1/2	60	32.4	44.5	42.5	49.5	45.0	48.9	53.8	52.5	46.7	47.0	53.2	39.5	39.5
5:30A	19	61	34.1	42.5	40.5	47.5	42.8	46.7	51.3	50.8	44.2	45.5	51.0	38.5	38.5

Table 14. Condition of Italian prunes in test packages at New York. Shipping tests from Milton-Freewater, Oregon 1944

Test No.	Car sym-bol	Treatment ^{1/}	Ship-ping date	Days in transit	Condition at time of arrival			Days to ripen	Condition after ripening		
					Firm-ness	Color ^{2/} Percent	Flesh color		Color ^{2/} Percent	Decay Percent	Dessert quality
2	N 2	Check; non-precooled	8-26	12	7.2	95		2	100	2	Good
	B 2	Precooled 8 hours	8-26	13	7.4	80	Amber	0	100	0	Good
	C 2	Precooled 13-1/2 hrs.	8-26	12	8.3	75	Amber	0	97	0	Good
3	R 3	Check; non-precooled	8-29	12	6.5	90	Amber	0	97	0	Good
	I 3	Precooled 8 hours	8-29	12	6.7	80	Amber	0	97	0	Very good
	J 3	Precooled 20-1/2 hrs.	8-29	12	7.2	60	Amber	0	97	0	Good
4	S 4	Check; non-precooled	8-31	14		60	Green amber	3	60	3	Fair
	K 4	Precooled 8 hours	8-31	14	3.2	85	Green amber	6	85	6	Fair to poor
	L 4	Precooled 19 hours	8-31	13	5.5	30	Green amber	0	85	0	Fair
Fruit picked at late maturity											
3	R 3	Check; non-precooled	8-29	12	5.7	90	Amber	1	97	0	Very good
	I 3	Precooled 8 hours	8-29	12	5.6	85	Amber	0	97	0	Very good
	J 3	Precooled 20-1/2 hrs.	8-29	12	6.3	75	Amber	0	97	2	Good
4	S 4	Check; non-precooled	8-31	14		98	Amber	5	98	5	Fair to good
	K 4	Precooled 8 hours	8-31	14	3.9	97	-	1	97	1	Fair to good
	L 4	Precooled 19 hours	8-31	13	6.7	95	Green amber	0	95	0	Fair to good

^{1/} In non-precooled cars 5 percent salt was added to the ice; in precooled cars 3 percent salt was used all during transit. Tests 2 and 3 were iced to full bunker capacity; test 4 to 3/4 bunker capacity.

^{2/} Percent purple.

Table 15. Rate of temperature reduction in fruit near the bottom
bunker opening

Car Number	Start	12	24	36	48	60	72	96
	°F.	hrs. °F.	hrs. °F.	hrs. °F.	hrs. °F.	hrs. °F.	hrs. °F.	hrs. °F.
NP 90094	70	49	40	36	36	32	29	28
NP 90256	70	48	41	37	34	34	34	34
NP 93083	76	46	40	39	38	38	38	34

